COMPARISON OF LATERAL CUTTING ACTIVITIES USED TO ASSESS ACL INJURY RISK

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INTRODUCTION

Side cutting has been identified as one of the most common mechanisms of non-contact ACL injury (Boden et al., 2000). In order to understand this mechanism of injury and to develop prevention protocols, a variety of experimental protocols have been employed. Of these, the unanticipated running and cutting maneuver may best replicate the conditions encountered during a game situation. Besier et al. (2001) reported greater muscle co-activation and greater loading of the knee as compared to an anticipated cut. While potentially having greater ecological validity than more controlled tasks, this activity presents many challenges as a broad screening tool. The protocol can be time consuming and logistically difficult to conduct. An experimental protocol where speed control and foot placement are less of a concern can be more easily implemented and may be better suited to large scale screening of athletes. Drop landings and stride jumps with a 90° side cut have been used to assess joint stability, but it is unknown whether the performance on these tasks reflect an individual’s ability to perform a running and cutting maneuver. Ideally, a simpler task would reflect movement patterns that under more stressful conditions would increase injury risk.

Drop landing and stride landing paradigms result in a either a nearly vertical or horizontal approach velocity. Another variation of these tasks is to place the box further from the landing target in order to generate both vertical and horizontal velocity components. This type of task may produce responses that better reflect game stresses. The purpose of this study was to compare the knee joint dynamics for individuals performing side cutting maneuvers starting from a static position to an unanticipated running and cutting maneuver.

METHODS

Five males and six females participated in this study. All were recreationally active and free from musculoskeletal injury. Each subject was asked to perform running and cutting maneuvers where they were randomly cued to either run straight, stop rapidly, or cut 45°. Subjects also performed 90° side cuts immediately upon landing from the three approaches; a) a box height equal to their maximum jump height set close (CL) to the force plate, b) a box at the same height set far (FL) from the force plate (distance = three times box height), and c) a stride landing (SL) from level ground (maximum single stride distance). Five trials of each task were recorded.

Three-dimensional kinematic data were collected using a seven-camera Motion Analysis Eagle system (200 Hz), and force data were collected with an AMTI force platform (1000 Hz). Three-dimensional knee joint kinematics and kinetic were calculated, and touchdown angles, maximum joint excursion, range of motion,
and peak moments were extracted for each plane. A repeated measures ANOVA was performed for each dependent variable ($p < 0.05$). A factor analysis was also performed in order to assess how individual performances across tasks were related to one another.

**RESULTS AND DISCUSSION**

Only knee sagittal plane kinematics were significantly different between activities with the cut exhibiting a smaller range of motion than the CL, FL, and SL tasks. Peak knee extensor moments were not different, but there were greater varus moments (Figure 1) and internal rotation moments during early stance.

![Figure 1: Group mean knee frontal plane moments. Black = Cut, Red = FL, Green = CL, Blue = SL. Positive values indicate a varus moment.](image)

The factor analysis generally reported that individual performances on the four tasks were highly related. For instance, the frontal plane range of motion resulted in a single principle component explaining 78% of the variance and the loading factors ranged from 0.728-0.942 for the four tasks. This indicates that an individual’s relative performance on one task was related to performance on another. Therefore, the easier landing tasks may serve as a reasonable indicator of an individual’s movement pattern during a cut. In contrast, the peak varus moment during the cut was related only to the peak varus moment observed during the SL task (Table 1).

<table>
<thead>
<tr>
<th>Task</th>
<th>Comp. 1</th>
<th>Comp. 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cut</td>
<td>-0.33</td>
<td>0.878</td>
</tr>
<tr>
<td>CL</td>
<td>0.94</td>
<td>-0.257</td>
</tr>
<tr>
<td>FL</td>
<td>0.979</td>
<td>0.14</td>
</tr>
<tr>
<td>SL</td>
<td>0.489</td>
<td>0.807</td>
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</table>

**SUMMARY/CONCLUSIONS**

Frontal plane dynamics have been identified previously as a discriminator of knee injury risk (Hewett et al., 2005). While the kinematic patterns of the cut, CL, FL, and SL tasks related to one another, only the SL produced a kinetic response in the frontal plane that related to the cut. Therefore, the stride landing may be the most appropriate of these tasks to use to characterize an individual’s cutting knee joint dynamics during play.

**REFERENCES**


**ACKNOWLEDGEMENTS**

UWM Graduate School Research Committee Award